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C. R. McCOMB
Chairman of Camsi, University of Toronto

In the last issue of the U. of T. Medical Journal an editorial was written on Camsi. In this, a number of criticisms were made of that organization, its purposes and its activities. Let me say that I agree with everything stated at that time; the accusations are warranted.

Information on Camsi should have been forthcoming from the Executive for a long time and in this article I shall not attempt to defend the activities of Camsi, but rather I will try to put the whole problem before you as I see it.

One year ago, my knowledge of Camsi and its activities was as limited as that of any medical student on this campus. I knew Camsi existed; I knew that ten cents of my money went to it every year, and that occasionally I received a copy of the Camsi Journal.

Then, in November 1944, we were presented with a brief on Health Insurance by the Camsi executive. I read this brief with keen interest. It was well prepared and effective. It stimulated a great deal of thought on this subject. Fine! But we were asked to vote on this brief the following week—our conclusions to be tabulated and handed it to the Canadian Youth Commission.

Health insurance I felt was a problem I could not and would not make a

decision on so hurriedly. Camsi had drawn up a brief on a very vital topic and presented it to us for a vote. In the brief it said "During the winter and spring of 1944, students at nine medical schools across Canada were discussing our national health," and "on May 6-7, after reports had been received from eight schools the composite brief was drafted in Kingston." Yet, the first time students at Toronto had heard of the whole affair was when they were handed a brief and asked to vote on it within three or four days!

We were being asked to decide in four days what we thought about Health Insurance under fourteen headings, and to allow this information to be turned over to the Canadian Youth Commission about which we knew practically nothing. I felt I could not decide on so important a matter in so short a time, when men who had been studying the whole problem for years had not yet reached a conclusion. Fortunately, the brief was voted on by less than thirty per cent of the students. The results were tabulated and never sent on to the Canadian Youth Commission.

This was the *first* time my interest was aroused in Camsi. The next time was occasioned by the elections for the Medical Society in December in which elections for Camsi officers were conspicuous by their absence. About Christmas it was decided that the time had come to elect new officers. Nominations were opened for a new executive. The new chairman was to come from my year (5th), but on the day nominations were to be closed, no one had been nominated for the chairman's position. This lack of interest seemed unfortunate, so I decided to run for the office of chairman, hoping to contribute toward restoring the original function and vitality of Camsi. The actual election was completely disorganized; however, it was finally announced that I was to be the new chairman.

My first move was to try and find out what constituted Camsi. Who better to ask that my predecessor? From him I received a talk on the high but vague ideals of the organization and a folder containing the minutes of four or five meetings of the Camsi executive of the previous year, a copy of the revised constitution, and a few pieces of correspondence. The meeting at which the old executive was to hand over the reins to the new one, never did materialize. By the end of January we decided it was time to get started.

At our first meeting I found that, except for one member, the executive was completely without experience in the organization; therefore we wrote to the National Casmi executive to find out their plans and to learn what was expected of U. of T. Camsi for the coming year. We found, also that no new project had been assigned to the Toronto branch at the previous conference so, while waiting to hear from them we decided to find out something about the various aspects of post-graduate work of medicine in Canada. To do this we sent out circular letters to the various Camsi executives, asking them to get some information from their respective schools on the subject. Our aim was to present this information in a consolidated report, but, unfortunately, we received absolutely no co-operation from any of the schools to which we wrote.

Meanwhile we looked into our financial backing, and our connection with the

U. of T. Medical Society. We discovered that the Vice-Chairman, Mr. McBirnie and I were non-voting members of the Medical Society, so after attending several of their meetings it was asked that we be made voting members. The request was granted. We fuither learned that in the past Camsi's only connection with the Medical Society was through the financial backing we received from it. We felt then, that complete cooperation with the Medical Society was essential in making Camsi an active organizaticn in Toronto.

When several months elapsed and we had not heard from either the National Executive or the other Camsi organizations, we were disappointed, and digcouraged. At this low ebb in our affairs, we found that there was an association interested in Camsi and its activities—the Canadian Medical Association. Dr. Agnew, its associate secretary, called me and suggested that we discuss matters of mutual interest. Among these were included Health Insurance, and student membership in the C.M.A. In spite of approaching exams we managed to get eight interested students and internes together at a dinner, which the C.M.A. gave for us, to talk over these problems. The evening was very interesting. At last, here were men of the profession who were interested in us and in what we did and thought, and they asked us to send a delegate to their National Convention in Montreal.

We did finally hear from the Camsi National Executive, but because it was so close to exams there was little we could do about it. So the winter and spring terms passed for the Toronto executive of Camsi.

This fall, under Camsi, a book exchange was started with the idea of serving first year alone. The exchange was so successful, it is hoped that it can be enlarged, to serve students of every year. Other than this, the better part of our fall term will be spent in the preparation of a report, containing suggestions and a good many criticisms and complaints, for the National Conference to be held in Winnipeg on the week-end of November 2nd.

You now will have some idea of the activities of Camsi in the past year. Before long there will be another election and a new executive. Let us, therefore, look at what has happened in the past and from it learn how to remedy the shortcomings of Camsi for the future.

To do this we must first examine the organization at each of the separate schools. Then we must look at the National organization. Under the present system the local organization is "a committee consisting of a Chairman, a Vice-Chairman, and a representative chosen from each year, completely independent of the local medical society, *but* dependent on it for its financial support." In other words, it is in no way responsible to the chief student organization and in no way connected with it. Under that system it will consist of a committee of eight persons. There lies the first error in Cami It has tried to remain independent in every sense of the word, although, according to the U. of T. Medical Society constitution, all medical student organizations must be subsidiary to the Medical Society and responsible to it. Camsi has become so independent that it has really no connection with the main student body. As it stands, Camsi defeats its own purpose. The two groups either overlap in the work they do, or they clash.

The purposes of Camsi include "the preparation of its members for medical citizenship." This aim is adequately taken care of by the Medical Arts and Letters Club which sponsor talks of interest to the students. The other two aims, namely the exchange of ideas and the pursuit of common objectives on a national basis, are not, and cannot, be taken care of by any student group other than Camsi.

I am suggesting that there should be a merger of the local Camsi executive with our Medical Society. As it is, the Medical Society consists of the year presidents and an over-all executive. Its members are the men who are interested in all activities of our school, and are closest to the opinions and activities of the individual student. This does not mean that the Camsi representative from each year may not be as capable as the year president but rather that he is not in a position to be as close to the students. In other words, my suggestion is the year representatives to Camsi be the year president; that the local Camsi organization be reduced to a committee of three or four persons to take care of the objectives of Camsi not otherwise looked after by the Medical Society. In this way Camsi can be truly representative of the student body.

The National Executive is, under the present system, equally deficient. A new national executive body is elected each year, and each new group must start from scratch. The official organ of the society is permanently situated in Montreal. Under such a system the National Executive cannot be as efficient as if the yearly executive were permanently placed in the same university. In this way, a central office for Camsi could be set up and carried on from year to year. Any local organization could refer to this permanent office and receive help.

One other problem remains to be solved. This is the relationship between Camsi and other national organizations. Until the present, men who have had the say in Camsi have cried over and over again, "Let us remain independent; let us not lose our identity." Yet, when the Canadian Youth Commission approached Camsi, these men were quite willing to become involved. Meanwhile, any mention of alliance with the C.M.A. has always been immediately vetoed.

An affiliation with C.M.A. would give us contacts with men who know and understand the problems of the medical student. It would give to Camsi some of the organization it needs badly. Yet this problem is not one which can be dealt with by the executive alone. It is up to the medical student body.

You may think from what I have said, that I am being very pessimistic and that I think Camsi is or will be defunct. I am not of that opinion. I think Campsi can and will serve a useful and important purpose on this and other campuses across Canada. I do think, however, that to achieve that position, the changes I have mentioned must be instituted. No doubt there are other glaring faults in the organization that I have missed. If any student feels he can offer constructive criticism, we shall be glad to hear it and if possible act upon it.

Any changes that may be brought about will take time, but there is no reason, with a return to more normal college conditions, the changes cannot be made. We hope for a Camsi re-organization actively working for students and supported by them.

EDEMA —A SYMPOSIUM ON CLASSIFICATION, MECHANICS AND TREATMENT

ROBERT SLATER, 4T6

Edema by definition is an accumulation of fluid in the tissues. Its formation is dependent mainly upon changes in the following factors: (1) hydrostatic pressure in the capillaries, (2) osmotic pressure in the capillaries, (3) permeability of the capillary walls, and (4) lymphatic drainage. These may act alone or in various combinations. Retention of fluid in the tissue spaces is not usually clinically recognized until the affected tissues have increased 8-10% in size.

The Physiology of Fluid Balance

A—Gross Water Distribution:

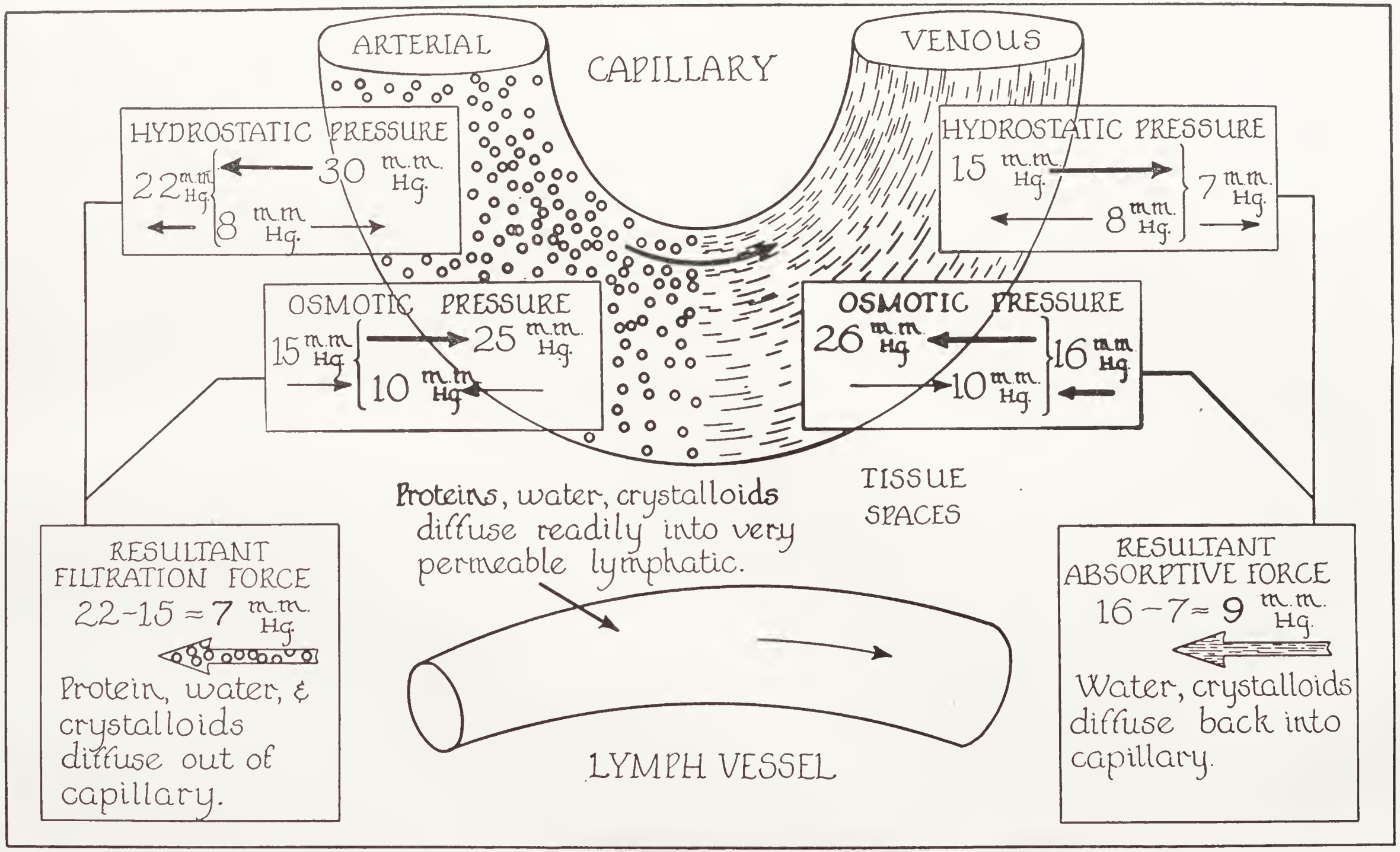
Under normal conditions the blood volume remains relatively constant despite the ingestion of large amounts of fluid or abstinence therefrom. Large quantities of ingested fluid are temporarily stored in the quiescent capillaries and tissue spaces of some organ (skin, muscle, liver and probably spleen), thus preventing dilution of the blood and permitting the normal lag of renal excretion and perspiration to "catch up" and reestablish water balance in the blood. The ingestion of sodium chloride or sodium bicarbonate slows excretion considerably and a fluid balance may not be resumed for a day or more. Under these circumstances edema may readily be produced.

B—The Factors of Hydrostatic and Osmotic Pressure:

Protein, water and crystalloids pass by filtration into the tissue spaces from the arterial end of the capillary loop. The lymphatic vessels reabsorb the protein, water and crystalloids, and the venous end of the capillary loop reabsorbs the water and crystalloids but not the protein. The main governing factors of this exchange may be explained as follows:

The hydrostatic pressure of the blood at the arterial end of the capillary loop is 30 mm. Hg., whilst that of the tissue fluid is 8 mm. Hg., thus giving a capillary filtration pressure of 22 mm. Hg. Counteracting this the osmotic pressure in the arterial capillary is 25 mm. Hg., that of the tissue fluid is 10 mm. Hg., thus providing a capillary absorptive pressure of 15 mm. Hg. The resultant balance between the hydrostatic and osmotic pressures at the arterial end of the capillary eventuates in a mean filtration pressure of 7 mm. Hg.

Conversely at the venous end of the capillary loop the process is reversed. The hydrostatic pressure of the blood has fallen to 15 mm. Hg., remains 8 mm. Hg., in the tissue fluid, resulting in a filtration force of 7 mm. Hg. However, due to the outflow of blood constituents during the capillary circuit the plasma proteins become more concentrated at the venous end, resulting in an increased osmotic attraction. This produces an absorptive force which overrides the diminished hydrostatic filtration force, and therefore a return of fluid from the tissues to the blood is effected. With reference to proteins and osmotic attraction it is well to note that the albumin fraction plays the important role. Its molecules



SCHEMATIC REPRESENTATION OF THE MAIN FACTORS INFLUENCING INTERNAL FLUID DISTRIBUTION

are smallest and in the greatest number, and because they present the greatest surface area they exert the greatest osmotic attraction. It is the albumin that constitutes the major proportion of the protein element of tissue fluid.

C—The Factors of Membrane Permeability

Capillary walls are semi-permeable membranes and their activity consists of selective filtration of certain elements of the blood as outlined above. Injury in any form to the capillary wall will increase its permeability and disturb the balance between blood and tissues. Capillary permeability is increased by: (1) anoxia, (2) the stretching of the capillary wall during increased hydrostatic pressure, (3) increase in temperature, (4) intoxication by various drugs or toxins, and (5) increased functional activity. As the selective action of the wall is exerted mainly towards the small albumin molecule, an increased permeability is accompanied by a greater outflow of albumin protein into the tissue spaces. A presence of more than 0.6% protein in the extravascular fluid indicates an increase in the permeability of the capillary membrane.

D—Other Factors Related to Water Exchange

It is now known that there exists in the hypothalamus of the brain a regulating centre for fluid, closely connected with the centres for the regulation of sodium chloride, metabolism, other mineral exchange, protein, carbohydrate and fat metabolism and other vegetative centres. Injury to this centre by experimentation on dogs is followed by an increased outflow of fluid from the blood to the tissues.

The hydrogen ion concentration of the colloids (plasma proteins) is directly related to the fluid balance. At the iso-electric point the colloid particles attract a minimal quantity of water. However, a change to pH to either acid or base side will increase the osmotic attraction of the colloids, thereby influencing the fluid balance.

The Pathology of Fluid Balance

I. Dependent Edema

A—*Gravitational Edema*

This occurs about the ankles and feet in a certain percentage of normal individuals after standing for prolonged periods without adequate exercise. It is due to increased venous hydrostatic pressure and secondarily to increased vessel permeability due to the anoxia of sluggish circulation. Since this edema occurs most commonly in the hot summer season, it is suggested that capillary dilatation may play a part. It is worse in heavy individuals and women are more noticeably subject. Varicose veins greatly favour this condition.

TREATMENT:

1. Rest with elevation of the dependent parts.
2. A reduction in weight is always good advice to an obese person.
3. Treatment of varicose veins by bandages, injection or ligation may be necessary.

B—*Cardiac Edema*

The heart fails on one side or the other, depending upon which is subjected to the greatest strain. If the left heart fails first, the dependent edema is preceded by pulmonary congestion and its sequelae. If the right heart fails first the dependent edema usually appears without preceding pulmonary complications.

The condition is due mainly to venous congestion causing a backing up of pressure in the capillaries. The increased venous hydrostatic pressure inhibits adequate reabsorption of tissue fluid. The increased pressure stretches the capillaries and increases the permeability of their walls, thus allowing a greater outflow of plasma constituents. The stagnation of sluggish circulation produces anoxia of the capillary membrane, this being a very important factor in the increased transudation of fluid.

The increase of venous pressure may be due to an inability of the right chambers of the heart to pass on all the blood they receive (i.e. tricuspid stenosis, pulmonary stenosis, fibrosis of the lung, mitral stenosis, etc.), or an inability of the right heart and vena cava to carry normal or increased flow due to pericardial effusion inhibiting expansion of the vessels and chambers.

The mean capillary pressure comes to exceed the osmotic pressure of serum proteins and fluid is then diverted from the kidneys to the interstitial spaces. Slight or moderate congestion facilitates kidney function by increasing the kidney capillary hydrostatic pressure, but severe congestion compresses the tubules and distends the glomeruli, impedes renal filtration and results in the retention of waste metabolites. The accumulation of tissue fluid is initiated when the venous pressure is raised above the normal of 6-8 cms. of water to 15-20 cms. of water.

It must be remembered that the protein concentration in the capillary filtrate varies with the serum protein concentration as well as the permeability of the capillaries. Johansen suggests that original transudates contain relatively small amounts of protein, but that these increase as the transudates persist or while they are undergoing absorption, because water and diffusable solutes can be removed more rapidly than protein, the former being removed by capillaries and lympathics, the latter only by lymphatics.

Iversen and Johansen also point out that the degree to which a protein can become concentrated in a serous cavity depends upon the same factors that determine transudation, namely the colloid, osmotic and hydrostatic pressures in the capillaries and transudates. High concentrations can be produced only when the colloid osmotic pressure of the serum is high in proportion to capillary blood pressure. In this connection it is necessary to consider the negative intrapleural pressure in evaluating the forces which determine pleural transudation. This may be the reason that in any given individual, protein is usually more concentrated in pleural than an ascitic fluid.

TREATMENT:

1. Bed rest reduces cardiac work and also gravitational pressure below the heart level. This should be continued until the edema has disappeared and signs of cardiac failure overcome.

2. Digitalis is by far the most efficacious cardiac drug. It strengthens the force of systolic contraction and results in a more complete emptying of the ventricle. This permits a greater filling, thus relieving the congested venous system. Since contraction time is shortened, heart muscle is permitted a longer diastolic rest and filling time. Apparently digitalis also increases the mechanical efficiency of heart muscle. Digitalis does not necessarily produce cardiac slowing unless auricular fibrillation has occurred, and may cause a conspicuous improvement in heart failure without the intervenion of primary cardiac slowing.

Digitalis powder should be administered in a dosage of 0.4 gm. t.i.d. for three days and then be reduced to a maintenance dose of 0.12 gm. per day.

3. Salt restriction is a "must" (2 gms. per day).

4. Fluid restriction to 1 litre per day; the amount may be gradually increased.

5. An acidifying diuretic such as ammonium chloride or ammonium nitrate can be used. If not effective, administration must be ceased and another type tried—possibly a mercurial preparation.

6. An adequate diet must be ensured in order to overcome any malnutrition element of the edema.

C—*Hypostatic Edema of the Lungs*

This condition occurs as a complication in patients, usually of the older age group who are bedridden for some unrelated disease. There occurs a gradual accumulation of fluid posteriorly in the lower lobes of the lung, first in the interstitial spaces (alveolar walls), then plugging the alveoli. This greatly diminishes the natural resistance of the lung tissues, and pneumonia is a common sequel.

The mechanism is as follows: when a patient is lying motionless in bed the lungs are being exercised minimally. A goodly proportion of the lung and lung capillaries are not being aerated. The excellent lymphatic drainage of the lung is reduced to minimal working efficiency due to the lack of exercise (i.e. to massage the lymph vessels). This combined with the anoxia of the capillary walls which are not adequately aerated, thus increasing their permeability, allows fluid to accumulate extravascularly. It is often found that hydrothorax appears only in the right pleural cavity or, if bilateral, that the right is more abundant. The popular explanation of this phenomenon is that an enlarged right auricle presses on the Vena Azygos Major vein thus initiating more transudation on the right than the left.

TREATMENT

1. Forced deep respirations at regular intervals.

2. Frequent change in body position—turning from one side to the other—prevents accumulation of fluid in one area.

3. Drinker believes inhalations of pure oxygen even at two atmospheres pressure is definitely beneficial because of the anoxic factor. Its success has been proven with dogs.

II. Generalized Edema

This classification of edema, often called anasarca, is, apart from the nephritic type, usually chemical in origin and due to some disturbance in blood protein or tissue metabolism. As implied by the heading, it is not localized in its distribution although it often starts as a localized swelling.

A—*Renal Edema*

(1) Nephritic Edema.—Acute glomerulonephritis accounts for this well known variety. The latest theory credits it to a generalized increase in capillary permeability, but fails to elucidate whether it is an allergic response or a toxic response of the capillaries. It is known that there is increased capillary permeability because the edema fluid contains over 1% protein, and .6% is normal for tissue fluid. Eppinger calls it "albuminuria into the tissues." If it be presumed that the capillary damage is toxic in nature, in which kidney glomerular capillary damage is paramount, this may be called an inflammatory edema. Once the edema is established, the chlorides pass out into the tissue spaces with the water, hence the retention of chlorides in glomerulonephritis. This acts as a secondary cause of edema, actually a vicious circle. The sodium ion, which travels with the water, increases the osmotic attraction in the tissues (electrolytic attraction). Albuminuria is due to the increase in renal capillary permeability. However, it is not usually gross in the acute stage.

TREATMENT

1. Complete bed rest until the general manifestations of the disease have disappeared. If the urinary findings persist to a degree after two months but the extrarenal signs have vanished and blood sedimentation rate has returned to normal, the patient may be allowed to resume slowly his usual routine. Any recurrence of signs must of necessity send him back to bed. Avoidance of cold and infection are "musts."

2. Salt restriction until recovery.

3. 800 c.c. milk diet must be adhered to until improvement is shown when a milk substitute diet may be initiated, and then the gradual supplement of regular diet.

4. No drugs are indicated except in the presence of hypertensive encephalopathy, in which 15-30 grams of magnesium sulphate per os per day or 25 c.c. of 10% soln. of the same may lower the blood pressure and prevent convulsive seizures.

5. The eradication of foci of infection such as diseased tonsils, abscessed teeth, etc., is recommended.

(2) Nephrotic Edema.—This type of edema is characteristic of nephrosis and sub-acute nephritis, and also renal amyloidosis. The syndrome is massive albuminuria, massive edema, cellular casts, hypercholesterolemia, anemia and usually relatively normal blood pressure. The great loss of albumin is glomerular in origin however, the tubular degeneration may also add albumin to the urine. The increased permeability of the glomerular capillary membrane, which nor-

mally prevents the passage of albumin, now permits, for an incompletely understood reason, great quantities of albumin to escape.

One theory advanced by Dunn suggests that there occurs a fixed patency of the glomerular capillaries, a loss of their normal rhythmical contractility, and thus more glomeruli are in operation simultaneously. The same amount of blood is thereby distributed to more glomeruli, resulting in partial asphyxia and stasis of the blood plus slight capillary dilatation which permits the escape of albumin.

The edema of this stage is entirely different from that of the acute stage. There is now a reversal of the albumin-globulin ratio from the normal of 3 to 1. The great drop in colloid osmotic attraction of the plasma permits increased outflow of fluid to the tissues. This is a transudation in the true sense, and the protein content of the edema fluid is below 0.1%. The retention of chlorides occurs automatically with the retention of fluid.

TREATMENT

1. Bed rest until treatment is successful in eliminating the edema and effecting kidney function improvement.

2. A diet with adequate protein (not necessarily high protein) content is of great benefit.

3. Salt restriction is a necessity, and this includes all forms of sodium salts such as sodium bicarbonate.

4. If the edema is causing disquieting symptoms, diuretics may be employed. A saline diuretic (ammonium chloride, 3 to 6 gms. per day) should prove effective.

C. *Malnutrition Edema*

This condition results from an inadequate ingestion of protein in the food (starvation), thereby causing lowered serum protein level. The decrease in osmotic absorption results in increased extravascular fluid retention. Congestive failure accompanied by malnutrition results in edema, because: (*a*) lowered serum protein inhibits the return of tissue fluid to the vessel; (*b*) increased hydrostatic pressure causes increased outflow to the tissues and also stretches the capillaries making them more permeable. In any condition the edema threshold appears when plasma proteins fall below 3-3.5 gm.%, and the albumin fraction below 1.5 gm.%, irrespective of the globulin level.

TREATMENT

1. Primarily an adequate diet with high protein content is essential.

2. If the condition is perilous, plasma intravenously may tide the patient over until dietary therapy has effected an improvement.

3. Salt restriction is beneficial until the edema has started to disappear.

Avitaminosis B_1 (Beriberi).—Included here must be the edema of avitaminosis B_1. This in the majority of cases will simply be one factor of general malnutrition, and thus dietary therapy is the main indication. However, if a true case of beriberi is diagnosed, that is, nutrition faultness except for avitaminosis B_1, then the edema is attributed to heart failure arising from a specific lack of thiamine.

Thiamine is a coenzyme in the chemical process of oxygen utilization in carbohydrate metabolism. It will be readily understood that any interference in the utilization of oxygen by the body tissues will endanger the health of those tissues. In the cardio-vascular disease of dietary origin, one of the pathognomonic features of the syndrome is increased blood flow due to arteriolar dilatation. Within a few hours after the administration of thiamine, the rate of blood flow is reduced and the utilization of oxygen is increased. If edema is present due to myocardial insufficiency, diuresis results after proper therapy.

TREATMENT

Thiamine hydrochloride, 100 mgm. daily intravenously.

D. *Anemia Edema*

Anemia is generally considered only a contributory cause of edema. It is believed that the fluid retention arises due to a disturbance of the balance between capillary blood pressure and the osmotic pressure of serum and tissue proteins. Reduction in the serum albumin so slight that it would ordinarily produce no effect, in combination with anemia, will regularly produce edema. If the anemia is sufficiently profound anoxia increases the capillary permeability with the obvious results.

TREATMENT

1. Whole blood transfusion may be necessary.
2. Adequate dietary therapy.
3. Specific anti-anemic measures (iron, liver extract).

III. Localized Edema

A. *Inflammation Edema*

Inflammation is the commonest cause of localized edema. The mechanism is: (1) increased capillary permeability due to toxic irritants, (2) increased hydrostatic pressure due to venous thrombosis. This accounts for the swelling of the inflamed area.

TREATMENT:

1. Complete rest to the affected part until the inflammation subsides.

B. *Lymphedema*

This condition is caused by obstruction of the lymphatics, and although not common, occurs mainly in the lower extremities. Chronic inflammation, extensive trauma, and neoplasms of an infiltrating nature may give rise to lymphatic obstruction. Examples of this state may be cited: (1) elephantiasis of the leg or scrotum due to filarial blockage of the lymphatics, (2) non-parasitic elephantiasis mainly in young women due to chronic lymphangitis of unknown origin, (3) Milroy's hereditary edema of unknown origin, (4) swelling of the arm in carcinoma of the breast.

Because the nature of the disease is a lack of lymph absorption, the edema fluid has a high protein content, approaching 4%, at any rate considerably higher than that of hypostatic edema. By elevating the legs and hips the edema fluid gravitates to the back, where it is readily absorbed with a resultant copious diuresis. The administration of diuretics has little effect on lymphedema.

Obstruction of the thoracic duct has the same effect as outlined above, but involves also the peritoneal and pleural cavities. The fluid contains, in addition to a high protein level, a high lipid content due to intestinal absorption of fat and it appears opaque or milky.

TREATMENT

Surgery is the only measure which offers permanent relief.

C. *Edema due to Obstruction of Venous Trunks*

In this circumstance there occurs a transudation into the tissues drained by the involved veins, but since the lymphatics remain intact there does not accumulate such a great proportion of protein in the tissue fluid. This type of edema does not tend to become as massive as lymphedema, where the high protein osmotic attraction in the tissue spaces readily attracts fluid from the capillaries. Venous thrombosis, varicose veins and constricting bands are all potential causes here.

TREATMENT

1. Motions of the legs or affected area increase the flow of lymph (and also blood drainage), and thus enhance the reabsorption of fluid. This treatment would have a negligible effect on lymphedema.

2. Bandaging the limbs to provide external support increases the extravascular tissue-space tension (i.e. hydrostatic pressure in the tissue spaces) and is quite successful.

3. Treatment of varicose veins or removal of constricting bands is an essential.

4. Bandaging and keeping the limb warm—keeping it elevated except when it is exercising in the dependent position offers the greatest relief.

5. Duncan believes that general dehydrating or diuretic measures employed in these local disorders are not justified, due to the distress caused in proportion to the small amount of relief given.

D. *Edema of Portal Obstruction*

A fibrous or neoplastic replacement of the liver produces ascites primarily and subsequently edema of the lower extremities. This edema is due not only to the obstruction (increased venous and capillary hydrostatic pressure), but also in cirrhosis of the liver to the disturbance of plasma proteins. The globulin fraction is irregularly increased whilst the albumin fraction is decreased, and when this occurs edema becomes manifest (i.e. below 1.5 gm.%).

It may be well to mention at this point that the formation of a transudate

ascites is believed to be due to the simple phenomenon of filtration. The tissue spaces of the peri-peritoneal tissues become waterlogged first, and due to this increased tension, fluid seeps through the peritoneal serous membrane to collect in the cavity.

TREATMENT

1. The fall in serum protein and resultant ascites may be prevented by a diet consisting of easily assimilable carbohydrate and milk protein with low fat content. Some workers have recommended large quantities of Vitamin B.

2. If ascites is present to such an extent as to defeat the dietary regime, paracentesis must be done and every effort made to prevent reaccumulation of the fluid.

3. Salt restriction and the administration of urea (20-60 gms. per day) aid in the promotion of diuresis.

E. *Angioneurotic Edema*

This is a swelling of urticarial character and may be nervous or allergic in origin. The fluid of the edema contains a relatively high concentration of protein, which Govaerts believes is due to an increased capillary permeability subsequent to vasomotor disturbance. (Vasomotor influence: sympathetic nerves are constrictor, parasympathetic are dilator.) Angioneurotic edema may occur in the skin, mucous membranes or viscera. The lesion is usually transient and circumscribed, persisting for a few hours or sometimes a number of days. It may occur without sensory phenomenon or with itching, burning or prickly sensations. One form is hereditary and may terminate in fatal edema of the glottis.

TREATMENT

1. The search for an allergy to a specific food and its elimination from the diet may be successful.

2. Epinephrine (0.5 cc. of 1/1000 soln. subcutaneously) and cold applications may be temporarily beneficial.

3. Ephedrine (0.05 gm. per os t.i.d.) may lessen or abolish the symptoms.

4. Tracheotomy may be necessary in edema of the glottis.

The foregoing is only a brief summary of an immense subject. Many excellent reviews have been prepared from time to time by various workers and to these the inquiring student is referred.

The author takes this opportunity to sincerely thank Dr. William Boyd and Dr. Robert MacMillan, who have given so freely of their time in the composition of this article; and also to Miss Anne McGregor and Miss McArthur for their invaluable assistance.

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ELECTRIC SHOCK THERAPY IN MENTAL DISORDERS

DONALD CURRIE, 4T7

Electric shock therapy in the treatment of mental disorders was first used by Cerletti and Bini in their clinic in Rome in 1938 (1). Due to its simplicity and excellent results, its usage has spread rapidly and has been used in this country since 1940. It already has earned a prominent position as a therapeutic tool in psychiatry and has in many clinics replaced the convulsion treatments induced by chemical means.

Indications

The most important indications are the depressions which include involutional melancholia, manic-depressive psychosis, depressed phase, and reactive depression. It is well established that the involutional melancholias and manic-depressive patients do better than the other groups. In long standing cases as well as in early treated cases, the prognosis is good (6); the duration of psychotic illness does not present an obstacle as it does in other psychoses.

The prognosis in the schizophrenias is not as good as in the depressions. The shorter the duration of the illness, the better the results; the longer the duration of the psychosis, the less possibility there is for improvement. Reznikoff (6) states that treatment of schizophrenics ill longer than five years is practically useless except to make them better institutional patients. Those schizophrenics whose symptomatology is dominated by catatonic features are said to do best but unfortunately relapses are frequent (6). It has been said that in the paranoid type, the effect has been chiefly to remove the delusional and hallucinatory experiences. The true schizoid personality has not been changed at all.

This treatment has been used on the psychoneurotics; the percentage recoveries has been less than with the depressions (2). In general paresis, electric shock therapy has been used to overcome agitated and excited patients. In this case the therapy does not alter the fundamental psychosis which must be treated by the usual methods.

Contraindications

The chief contraindications for any convulsive therapy are cerebral lesions, tuberculosis, either active or inactive, advanced heart disease regardless of the aetiology, bone diseases with the possible exception of osteoarthritis, malignant tumours, either active or "cured," inanation, thrombophlebitis, glaucoma, or any other conditions which in the opinion of the clinician would make drastic therapy unwise (2). These contraindications nevertheless are relative, for the psychiatrist must weigh the prognosis of the mental illness against the patient's health. It is suggested that in addition to the routine laboratory checkup, an electrocardiogram, and electroencephalogram, and X-rays of the spinal column be taken in most cases. The blood pressure deserves special consideration and its determination should never be omitted prior to treatment. It has been found that

after treatment the systolic pressure is 3-5 mm. higher, the diastolic 5-7 mm. lower than the pressures before treatment. Nevertheless, during the convulsion, the pressure probably rises higher than these figures indicate due to the generalized muscular contractions. Therefore, marked arteriosclerosis with or without hypertension presents an added risk.

Apparatus and Technique

The electrical control mechanism is designed to serve two essential purposes. Firstly, a slow trial galvanic current is used to measure the resistance of the patient's head to the electrical current. From this measurement, the proper minimal voltage necessary to induce a convulsion may be found. Generally, one milliampere of current is used and the resistance of the head thereto may be given in ohms. This operation is quite beyond the patient's sensation. Secondly, the apparatus produces the shock itself. For this, alternating current (either 25 or 60 cycles per second) is used. This circuit contains a voltmeter from which the operator can determine the voltage to be applied, a milliammeter by which the amount of current used may be determined, and an automatic clock interrupter which breaks off the current after the desired time interval. The current used ranges between 200-400 milliamperes at 80-100 volts for 0.1-0.7 seconds. Should the current first used be insufficient to produce a convulsive seizure, Bini (8) advises an increase in voltage rather than an increase in time.

It is generally accepted that the grandmal seizure is of more benefit therapeutically than the petitmal seizure (5). There is a retrograde amensia of the treatment when a grandmal seizure results, whereas when a petitmal seizure results, the patient can often remember the treatment and becomes terrified of subsequent treatments. It has been found that resistance to treatments tends to increase with the number of shocks, that delayed convulsions are usually the more severe, that the size of the skull has no bearing on the response to electric shock, and that those patients who submit to treatment willingly seem to require a smaller voltage than the more resistive patients (5).

Treatment is given early in the morning. The patient is dressed in his nightclothes and has received neither breakfast that morning nor sedation the night before. He lies on his back on a firm bed with a sandbag under his midthoracic vertebrae. Assistants are instructed to lightly restrain movements of his arms and legs. Electrodes are applied to his head over each frontotemporal region with some electrolytic jelly. The resistance of the patient's head is quickly measured by the operator. A gag is placed in the mouth and the patient is instructed to bite on it. An assistant extends the head at the neck by pulling upwards on the chin. The operator then administers the shock. If the patient does not take a grandmal seizure the operator administers a second shock. The patient's convulsive movements are lightly restrained. In a half minute or so when the patient ceases the convulsion, he is firmly tucked in his bed and stays there until he passes into deep slumber. Electric shock treatments may be given twice weekly for a five-week period. If a patient shows slow improvement as many as 25 or 30 treatments may be given. Acutely ill patients are treated more often, even twice daily.

The Convulsion

On closing the stimulating circuit, one of two responses occurs: (1) a generalized convulsion (grandmal seizure) or (2) a state of unconsciousness with little or no motor manifestation (petitmal seizure). The petitmal seizure is considered insufficient therapeutically; a second shock is administered which generally results in a gradmal seizure. There is a latent period of response which varies from one to thirty seconds. The longer this period, the more severe the convulsion. The patient immediately loses consciousness upon closure of the circuit and remains unconscious throughout the seizure. The convulsion proper resembles a generalized epileptic grandmal seizure. There is an initial generalized jerk, a tonic phase in which all skeletal muscles respond by tonic contracture, and a clonic phase in which the patient exhibits clonic movements of his limbs and trunk. Both respirations and heartbeats cease during the convulsion. The concentrations of cholestrol, phospholipids, serum protein, inorganic phosphate and blood sugar are temporarily raised (4). In 30-60 seconds the convulsion is over, the respirations begin, quite stertorous at first and the heart resumes its contractions. The patient remains unconscious for about five minutes. The patient may show a post-convulsive excited state during which he must be restrained in his bed. The patient usually passes off into a deep sleep which lasts for an hour or two. All patients who have a grandmal seizure exhibit a retrograde amnesia of the whole procedure when later questioned—an inestimable advantage when compared with the chemical convulsion treatments by metrazol or insulin.

Complications

The most common complications are fractures and memory defects. The middle four thoracic vertebrae are liable to compression fractures but this is uncommon when a firm pillow or sandbag is placed under the patient's chest. Fractures of the long bones of the limbs may occur but these are reduced to a rarity when the assistants extend the limbs prior to stimulation, apply light restraint upon stimulation, and carefully watch the patient after the convulsion. The fracture rate is below 5% whereas the metrazol fracture rate was 22 % (2).

Memory defect is never permanent and is "spotty," usually for proper names, places and dates. No neurological sequelae have been recorded to date. Pathological change observations have been limited to experimental animals. Permanent changes were rare; punctate cerebral haemorrhages were found in cats (5). In humans, alarming apnoeas are rare. One should never hesitate to apply artificial respiration should the need arise. It is suggested that both epinephrine and caffeine-sodium benzoate solutions be kept nearby.

Advantages over other Shock Therapies

With electric shock therapy, the convulsions tend to be less severe. The fracture rate us about 5% as compared with a fracture rate of 22% with metrazol. The patient has no recollection of, and is consequently not terrified by, the electric shock treatments. Electric shock treatment is more easily administered to the unco-operative patient in whom venipuncture would be difficult. The method

is simple in application and is inexpensive to the patient. The ill effects of treatment in reference to cardiac stress and strain have been found less severe than similar effects with insulin and metrazol therapy, perhaps because of lack of side effects of these drugs (2). In the long run the results may prove to be superior to the results of the other shock therapies. Disadvantages of this form of treatment which may be mentioned are (1) electric shock is a respiratory depressant, and (2) the memory loss may be greater than with the other forms of shock therapy.

Results

Since the results reported by the various writers consulted do not closely parallel each other, it is felt that the best way to convey an impression of the benefit of this form of treatment would be to give a small range of percentage recoveries and improvements for each psychosis which would be in keeping with the results of any one author. By recovery we mean a sufficient improvement which would warrant hospital discharge; by improvement we mean that due to this treatment, the patient has become more manageable in the hospital routine.

Involutional melancholias shows some 70 to 85 per cent recoveries, of the remaining 15 to 30 per cent about half improve. Manic depressive psychosis, depressed phase, shows 60 to 70 per cent recoveries, whereas in the manic phase the percentage recoveries is much lower. Schizophrenic patients seldom recover with this treatment: 15 to 20 per cent improve. It has been reported that in the schizophrenias the chief benefit has been to lower the frequency of the delusional and hallucinatory experiences. From 50 to 60 per cent of psychoneurotic patients of all types have recovered wtih electric shock treatments.

Summary

We have here a method of inducing convulsive seizures which presents many distinct advantages over formerly used methods and which materially reduces the length of hospital residence of most patients under treatment. The method is simple and relatively safe. Very encouraging results have been recorded in the treatment of psychoses in which the main feature is a depression.

It must be remembered that electric shock therapy is of limited value per se. It should be combined with supportive psychotherapy and possibly occupational therapy and symptomatic medical treatment depending upon patient, to achieve the best results. Only when thus combined does the treatment reach its maximum therapeutic value.

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PAIN

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Introduction

Pain is a sensory experience which appears to be limited to animal life. It is probably one of the earliest of our developed senses, and is important as a warning of danger to the organism.

In man, pain is not absolutely essential for adjustment to his environment, because other sensations may substitute as warning signals. Moreover, man learns by experience to avoid stimuli likely to arouse pain.

Pain is likely to be the chief complaint of the patient when he consults his physician. The location of the pain, its quality, its duration, and the conditions that induce or relieve it, are indispensable aids to diagnosis.

It has been the problem of the physiologist to determine the mechanism of the sensation of pain. Animal experimentation has helped in this study, but animals are not very satisfactory subjects.

Since pain is a subjective phenomenon, only the human subject can inform the investigator of the location, and the nature of the sensation. Because of this, the inquiry has been undertaken by surgeons and clinicians who have had access to human subjects.

Varieties of Pain

Two varieties of pain are recognized: superficial pain and deep pain. Superficial pain has a pricking, burning, itching quality, and is easily localized. It commonly leads to action such as fight, or flight. On the other hand, deep pain is a diffused pain which has an aching quality, and often induces nausea. It usually causes the animal to stop and seek protection in withdrawal, inactivity, and rest. There are varieties of deep pain arising from muscle, web, and artery, which will be discussed later.

Pain Receptors

The sensations which may be aroused by stimulation of the skin are touch, cold, warmth, and pain (Fig. 1). Each of these sensations, with the exception of pain, is mediated by a receptor or sense organ possessing distinctive structural features.

The presence of discrete endings subserving the several cutaneous sensations enables small areas to be mapped out upon the skin, which are specific for one or other sensation. The areas are called touch, cold, heat or pain "spots" respectively, in accordance with the sensation which their stimulation arouses.

No agreement on the receptor for pain was reached until Tower applied to this study the technique of recording the impulses in single nerve fibres. She discovered that the element or unit of the receptive mechanism for pain, was not a small spot innervated by a single nerve fiber but rather an appreciable area

over which the terminal branches of one neurone were distributed. In the cornea Tower found that branches of one neurone extended over as much as one quarter to one half the surface area. In any area of normally innervated skin, many such unit terminals overlap and interlock intricately, but no interaction between neurones has yet been demonstrated.

The histology of the termination of the pain fibers in the skin has been greatly illuminated by the work of Dr. Wollard and his associates. Out of a nerve plexus deep in the corium (Fig. 2) there arises a superficial plexus of unmyelinated and thin myelinated fibers.

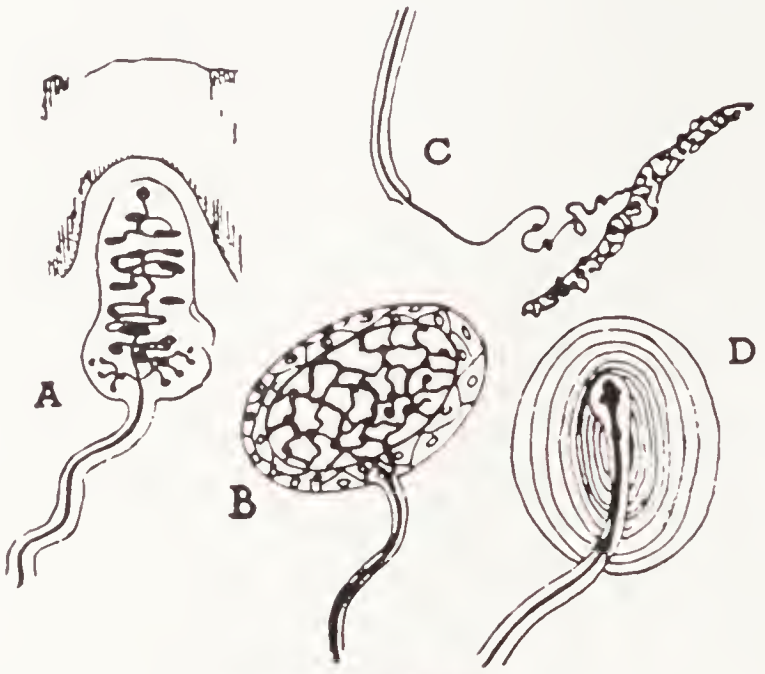

FIG. 1

FIG. 1. Cutaneous receptors. A, Meissner's corpuscle (touch); B, Krause's end bulb (cold); C, Ruffini's end organs (warmth); D, Pacinian corpuscle (deep pressure); E, bare nerve endings in cornea (pain) (in part from Bainbridge and Menzies, *Essentials of Physiology,* Longmans, Green and Co.).

The fibers leaving this superficial plexus are all unmyelinated, though they may have their origin in myelinated fibers. These naked fibers branch freely, and end in fine, beaded terminals beneath and between the cells of the deep layers of the epidermis. That these fibers are functionally homogeneous is indicated by the fact that when one of them is traced backward through the plexus, it is found to be associated with no other variety of ending.

It used to be thought that the production of pain was not a function of any one type of nerve ending, but that any skin receptor if stimulated with sufficient intensity would give rise to the sensation. This conception was first revoked by the experiments of Adrian, Cattell and Hoagland (1).

More recently, Woollard and Weddell have demonstrated that there are specific fibers for pain alone. However, it is still impossible to say that touch and pain are never carried in the same fibers.

The pain endings do not respond selectively to one variety of stimulus, but to any type whether mechanical, chemical or thermal, provided it be sufficiently intense. The sensation of pain therefore serves a protective purpose, giving warning of the injurious nature of a stimulus, rather than information as to any more specific quality.

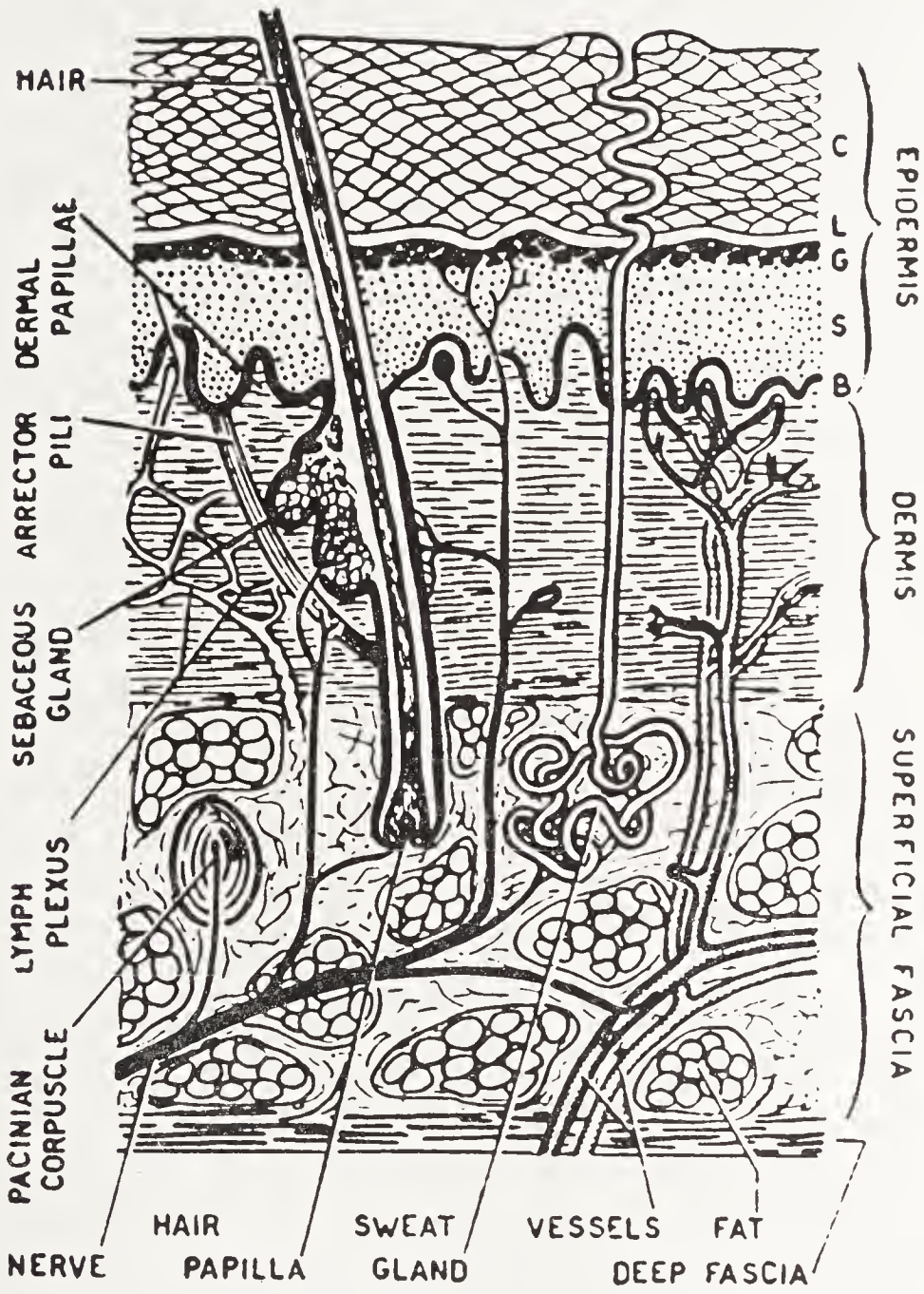

FIG. 2

Peripheral Nervous Mechanism of Pain

The fibers of sensory nerves are both myelinated and unmyelinated. Unmyelinated fibers are generally present in higher proportion (varied from 1:1 to 4:1).

All myelinated fibers in somatic sensory nerves are of the same kind (6), and all functional differences can be traced to the size of their axons (5). The action potentials are the same in configuration. However, in the viscera there are myelinated fibers with a different set of fundamental properties. Therefore, the

myelinated fibers of the sort found in somatic nerves (and also represented in visceral nerves) have been called A fibers, to distinguish them from the myelinated fibers with other characteristics called B fibers. The unmyelinated fibers in sensory nerves belong in the category known as C fibers.

Why sensory messages should be mediated by fibers of such different characteristics is not clear. The fastest sensory impulses originate in muscles. In the skin nerves, the highest velocities are in the region of 90 meters per second. Beginning with this value, there then appears in the A fibers a continuous range of velocities down to 10 meters per second. No fibers transmit impulses between ten and two meters per second, but velocities at two meters per second and slower appear in the C fibers.

Recent experiments (2) indicate that pain impulses have been differentiated into a slow group (conducted in unmyelinated C fibers at 1 to 2 meters per second) and a fast group (conducted in myelinated A fibres at 15-90 meters per second). This provides an explanation for an old observation about pain, the two distinct flashes of pain; the one coming almost at once, the other after a discernable delay. This double flash of pain can be experienced by flipping the back of the finger against a hot light bulb, or after a pin prick. The "second" sensation of pain is due to impulse conducted in C fibers.

It is interesting to note that itching and pain are functions of the same set of nerve fibers. Itching is mediated by the slowly conducting C fibers. Tickling, itching and pain are felt according to the frequency of impulses in these fibers.

Pathway and Central Representation of Pain Impulses

Sensory neurones for pain, temperature, and part of touch, enter the posterior horns of the grey matter of the spinal cord where they are regrouped. From the posterior horns, the fibers cross to the anterolatoral columns of white matter on the opposite side of the spinal cord, to constitute the spino-thalamic tract. The spino-thalamic tract can be divided into two parts—a posterior tract carrying pain and temperature fibers and an anterior part carrying touch fibers.

The neural mechanism by which painful stimuli enter consciousness has been the subject of much investigation, stimulated to a great extent by the successful relief of pain by operative procedures on the spinal cord and brain stem (3).

Pain may be appreciated at three levels. The highest level is the cerebral cortex. At this level there is the normal appreciation of pain, which may be illustrated by a pin prick. The sensation is associated with tactile and pressure impressions, which give it a localization as well as allow the appreciation of an acutely pointed instrument.

The second level of appreciation of pain is the thalamus. The normal function of the thalamus, however, is not so much the appreciation of pain, as its integration with other sensory modalities.

The third and lowest level of integration of pain is the tectum mesencephali. This is the centre which in phylogenetically primitive life perceived pain, but which in normal man probably rarely functions in that capacity, its powers being taken over by the thalamus and cortex.

Pain Threshold

The change to pain from an associated sensation, such as pressure or heat, is readily discernable. In the study of pain as a sensation, it is first necessary to define the pain threshold. The pain threshold may be defined as the amount of stimulus which will just barely produce a painful sensation under given conditions.

The threshold of superficial pain produced by thermal stimulations has been studied. Pain threshold in man is relatively uniform and stable when measured in instructed subjects, though emotional responses vary greatly. However, despite its stability under various circumstances in health, and its relative uniformity from one individual to another, regardless of age or sex, factors have come to light which alter the pain threshold.

Elevation of the pain threshold can occur for several reasons. (1) Damage to the nervous system may raise the pain threshold. (2) Analgesic drugs, such as acetylsalicylic acid, raise the level of the pain threshold effectively and predictably. (3) Attitude and suggestions may modify both the pain threshold and the manner of reaction to pain.

Circumstances which affect the condition of the skin, such as sunburn, calluses, or skin lesions, lower the level of the pain threshold. Schumacher postulated that the increased pain sensitivity was related to the presence of an inflammatory reaction in the tissues surrounding the pain end-organs in the skin.

Individuals vary in their sensitivity to pain. Some are almost insensitive to pain.

A much reduced pain threshold is observed when a lesion isolates the thalamus from the frontal and parietal regions of the cerebral cortex and produces the thalamic syndrome. A severe sensory loss is combined with an over-reaction to certain forms of stimuli, as pain and temperature. A patient afflicted with the thalmic syndrome will exclaim, "Something is happening to me, I am being hurt," instead of "You are sticking a pin into the back of my hand," because he fails to recognize the distinctive characteristics of the stimulus in question.

Pain Due to Local Cooling

When a subject's hand is immersed in cold water, two phenomena are known to occur. The subject experiences pain and an elevation of blood pressure is observed. The occurrence of pain received little attention until recently when Wolf and Hardy found a correlation between the degrees of cooling, the intensity of pain induced by the cold, and the height to which the blood pressure rises.

They induced a deep, aching, painful sensation by immersing a part of the body in cold water. The behaviour of this phenomenon was found to follow a definite pattern. Regardless of strength of stimulus, pain reaches its maximum in approximately 60 seconds. Thereafter, the pain gradually subsides, giving way to a sensation of "pins and needles" which is soon after terminated.

Pain due to local cooling is altogether separate from the sensation of cold itself. It is apparently mediated through small, unmyelinated fibers of class C. Its intensity depends directly upon the degree of cooling.

The amplitude of pulsation of the digital artery parallels inversely the intensity of "cold pain" experienced. Wolf and Hardy postulate that the stimulus of cold pain brings about a painful vasospasm of the part concerned. Relaxation of this local vasospasm may occur as the thermal gradient is decreased, thus accounting for "adaptation." It appears that the "cold pressor" affect is a measure of reaction to pain.

Pain in Ischaomic Muscle

When a muscle is exercised while the blood supply is cut off, extreme pain is experienced. Two views have been held as to the origin of this pain: (1) that it arises from the arteries; (2) that it comes from the muscle. However, little conclusive evidence was published until the work of Lewis in 1931. Lewis devised an apparatus for his studies on pain, which itilized the fact that pain arises when work is performed by an ischaemic muscle. He occluded the vessels of the subject's arm by means of a sphygmomanometer cuff. The subject grasped a metal bar and performed isometric contractions at a constant rhythmic rate until pain occurred. Lewis' experiments indicate that this pain is due to a tissue metabolite, which he called "factor P."

He believed this substance, accumulating in the tissue spaces of the ischaemic muscle, to be the sole cause of pain. The pain was dependent upon the amount of work done. By performing a constant effort at a constant rate, the subject experienced pain at a constant time. Restoration of the circulation dissipated factor P," and the pain disappeared almost immediately.

Cardiac Pain

The most widely accepted theory offered to explain cardiac pain is that of Lewis, who has suggested that the pain is due to the development of myocardiac ischaemia. He believes that, as a result of impairment of the coronary circulation, there occur changes in the metabolism of the heart muscle which lead to the rapid development of a hypothetical "P" substance, which acts as a pain producing stimulus to the nerve endings. The absence of pain in certain cases where ischaemia must be present is not so readily explained by this theory.

The possibility of a mechanical factor in the causation of cardiac pain has been proposed (7). Although the heart muscle is itself insensitive, there are numerous afferent sensory nerve fibers in the heart which do respond to painful stimuli. These fibers lie in the adventitial layers of the coronary arteries.

It is still a question whether the sympathetic nerve endings in the coronary arteries are stimulated by an unknown chemical substance resulting from ischaemia of the heart muscle or whether they may not respond to a purely mechanical factor such as tension.

Referred Pain

The term "referred pain" was first used by Head in 1893 in relation to visceral disease. When a viscus is diseased, pain or tenderness is frequently felt in the tissues approximately overlying it, or in some part quite remote from it.

For example, pain is felt in the neck or shoulder in conditions affecting the diaphragm, between the scapulae in gastric disease, and beneath the sternum or in the left arm in angina pectoris. A given spinal segment supplies a visceral area with autonomic nerve fibers and a well delineated area of skin (dermatome) with somatic nerves. The two types of structure linked in this way through the cord may be some distance apart (e.g. diaphragm and shoulder) or be more closely related (e.g. area of abdominal wall and an underlying abdominal viscus).

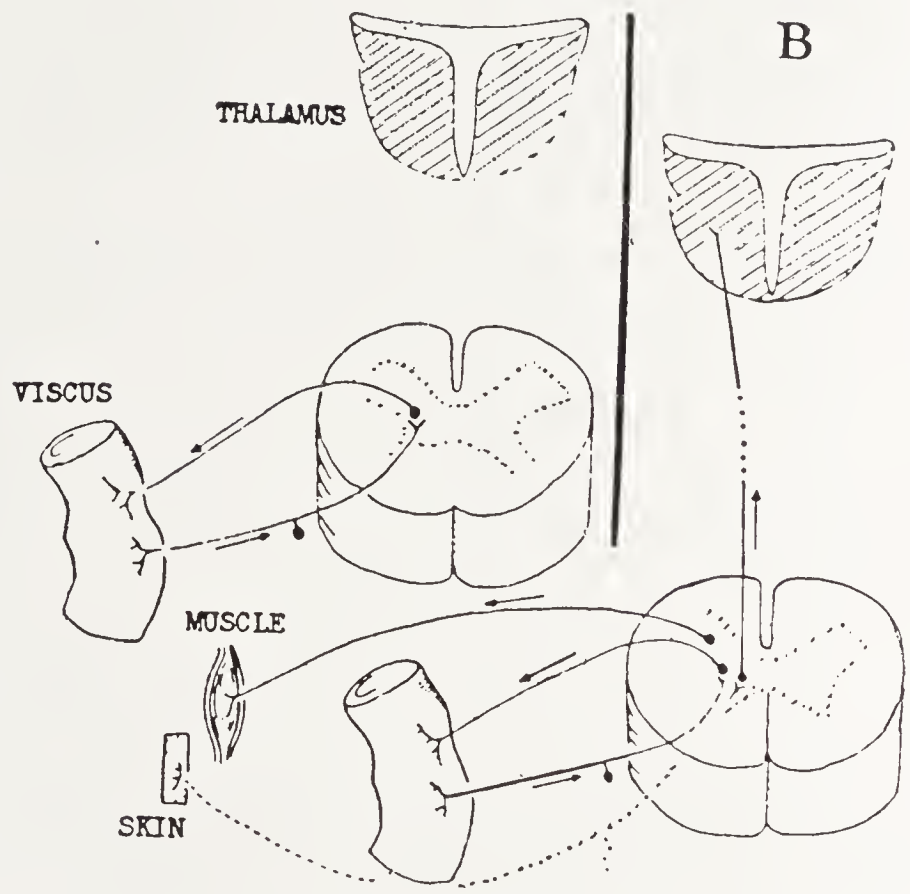

FIG. 3

FIG. 3. Diagram to illustrate Mackenzie's theory of referred pain. A, representing normal conditions, a visceral reflex is shown. B, illustrates a viscero-motor and a viscero-sensory reflex. Impulses from a viscus are conceived as setting up an irritable focus in the cord which through the involvement of neighboring neurons increases the tone of muscles innervated by the same segment, and causes a discharge of impulses over the pathway for pain. The sensation is then projected in consciousness to the periphery, as indicated by the dotted line.

The false localizations of pain arising from deep-lying somatic tissues, such as muscle, are of essentially the same kind as those happening in visceral disease, so that the term "referred pain" may be used as approximately for the one as for another.

Mackenzie (Fig. 3) conceived that afferent autonomic impulses arising in a diseased organ, though of themselves incapable of arousing any sensation, would upon entering the cord set up an "irritable focus" with the result that cells accustomed to receive some impulses from the corresponding somatic area were excited. The impulses arising in these cells then travelled along the usual paths to higher perceptive centres (thalamus) which projected or referred the sensation

to the somatic area. In this way *spontaneous pain* in superficial structures remote from the diseased site, were accounted for. Mackenzie spoke of these reactions as *viscero-sensory reflexes*. In the case of abdominal viscera, the area of tenderness in the abdominal wall remained fixed though the position of the diseased organ changed, thus indicating the referred nature of the pain. He explained the rigidity (hypertonus) of muscles overlying a diseased organ, the right rectus abdominis in acute appendicitis, for example, upon a similar basis, afferent impulses of normal intensity arising in the muscle proprioceptors upon arriving at the spinal centres, which has been rendered hyperexcitable by the receipt of abnormal visceral impulses, resulted in a reflex increase in tonus of the corresponding muscle. The referred motor reaction he spoke of as a *viscero-motor reflex.*

Morley contends that the referred pain of abdominal disease does not involve autonomic afferents as postulated by Mackenzie but is due to the stimulation of somatic pain fibers in the parietal peritoneum or mesentery, the sensation being referred to the superficial area innervated from the same segment. He enunciates what he terms the law of referred pain in the following words. Referred pain only arises from irritation of nerves which are sensitive to those stimuli that produce pain when applied to the surface of the body. He believes that the somatic innervation of the peritoneum extends along the mesentery to within a short distance of its attachment to the bowel, and does not terminate as has been generally supposed near the root of the mesentory. The mesentery or peritoneum is, therefore, sensitive to tearing, butting, etc., whereas the organ itself which contains only autonomic afferents is insensitive to these types of stimulus. He replaces Mackenzie's terms, viscero-sensory and viscero-motor reflexes by *peritoneo-cutaneous-radiation* and *peritoneo-muscular radiation* respectively. The pain and tenderness resulting from pressure upon an inflamed viscus (e.g. ulcer of the duodenum) through the abdominal wall he ascribes, however, to the parietal peritoneum being brought into contact with the roughened surface of the lesion. As evidence that the sensation is not, in such instances, referred to the skin from the diseased structure, but is due to the stimulation of nerves in the parietal peritoneum he cites the following observations, (*a*) the area of tenderness shifts with the movement of the viscus, (*b*) the tenderness is not abolished by infiltration of the skin with novacaine, and (*c*) direct pressure upon the inflamed organ when exposed by operation in a conscious patient (under local anaesthesia) does not give rise to any sensation.

Visceral Pain

STIMULATION OF VISCERA

The abdominal and thoracic viscera are insensitive to the several types of stimuli which readily arouse sensation in the skin and more superficial tissues of the body.

Sensations of pain cannot be elicited from the viscera by the usual means. The intestine or the liver, the stomach or the heart may be cut, burned, or pinched without arousing any immediate sensation. The insensibility of the alimentary

tract to ordinary forms of stimulation commences in the lower or middle third of the esophagus and extends as far as the commencement of the anal canal.

Several observers have made studies on sensation in the stomach, but their methods for the most part were either indirect or non-quantitative. Wolf has performed sensory studies on the gastric mucosa of a subject with a large, permanent gastric fistula. Various sensory stimuli were applied to the wall within the cavity of the stomach as well as to a redundant fold of mucosa protruding through the stoma. (Fig. 4.)

SENSORY STUDIES ON THE STOMACH OF MAN

S. WOLF AND H. G. WOLFF

1. *Heartburn*—due to stimulation of the mucosa lining the cardiac end of the esophagus.

2. *Nausea*—induced by the ingestion of irritating fluids.
—appeared to arise from the stimulation of adjacent structures rather than of gastric mucosa itself.

3. *Temperatures*—between 18 and 40°C.—no sensation.
—above and below this range, subject could accurately recognize changes in temperature of 3°C. or more as warmer or cooler.

4. *Touch*—no sensation.

5. *Pressure*—appreciated and roughly localized.

6. *Pain*—not elicited by normal stimulation (pinching or faradic current).
—produced by pressure with a blunt object or inflating a balloon, to 100 Cm/cm².
—vascular engagement, inflammation and oedema lowered pain threshold.

FIG. 4

Pain from Digestive Tract

Hurst, as early as 1911, proved that increased tension in the muscular wall of the gut was the appropriate stimulus for pain and that this was the only adequate stimulus. Distention usually causes pain and usually stimulates contraction distally. Before visceral pain can occur, when due to distention, the distention must be overcome or at least resisted by active muscular contraction.

The experimental production of pain in human beings, by distention of various small segments of the gastro-intestinal tract, from the esophagus to the rectum, has been studied. Sensations ranging from pressure or burning, to sharp pain were noted (Fig. 5). These experiments indicated that distention is the fundamental stimulus needed to produce the symptom of pain, and also that varying degrees of distention or "spasm" may result in the transmission of impulses over varying afferent pathways, with a reference to other points which are not usually involved.

SENSORY INNERVATION

Experimental observation on animals have shown that the internal organs are supplied with sensory nerve endings and that impulses run from these struc-

tures over the thoracic, splanchnic, hypogastric, and pelvic nerves to enter the spinal cord over the posterior roots (4).

Whereas the sensory dermatomes in man are now fairly well established, the exact segmental innervation of the viscera is still uncertain.

THEORIES OF VISCERAL PAIN

Many theories have been presented to explain the mechanism of visceral pain. Ross postulated that visceral pain was of two types, (*a*) *referred pain*, and (*b*) *true visceral or splanchnic pain*, which was diffuse, poorly localized, and arose in the viscus itself.

OBSERVATIONS ON EXPERIMENTAL PAIN PRODUCED BY DISTENTION OF THE GASTRO-INTESTINAL TRACT

Segment of Gastro-Intestinal Tract Involved	Localization of Pain
Esophagus	subternal pain at the level of balloon upper esophagus—midline over upper portion of manubrium cardiac end—tip of sternum
Stomach	epigastric
Duodenal Cap	midline or right epigastric
Middle and Lower Duodenum	midline in low epigastrium or high umbilical zone
Duodeno-jejunal junction	umbilical zone
Jejunum	high umbilical zone
Ileum	low umbilical zone
Ileocecal valve	McBurney's point
Colon	hypogastrium toward mid-line
Hepatic flexure *Splenic flexure* *Sigmoid*	approximately over part of bowel stimulated
Gall bladder	deep epigastric

FIG. 5

Lennander considered that abdominal pain was always due to the stimulation of somatic nerve terminals in the parietal peritoneum or mesentery. The bowel itself was believed to be quite devoid of pain fibers. According to this view, pain localized within the organ itself, that is *true visceral pain*, was an impossibility.

PAIN

I. *Definition*

II. *Varieties of Pain*
- (1) Superficial Pain
- (2) Deep Pain

III. *Pain Receptors*
- (1) Location
- (2) Termination in Skin
- (3) Specificity
- (4) Stimulation

IV. *Peripheral Nervous Mechanism of Pain*
- (1) *Fast Transmission*—A fibers
- (2) *Slow Transmission*—B fibers

V. *Pathway and Central Representation of Pain Impulses*
- (1) Posterior horn cells
- (2) Spino-thalemic tract
- (3) Three levels of integration
  1. Cerebral cortex
  2. Thalamus
  3. Tectum mesencephali

VI. *Pain Threshold*
- (1) Definition
- (2) Measurement
- (3) Changes in threshold with causes

VII. *Pain Due to Local Cooling*
- (1) Correlation between degree of cooling, intensity of pain, and cold pressor effect
- (2) Adaptation to pain
- (3) "Pins and Needles" sensation

VIII. *Pain in Ischaemic Muscle*
- (1) Arises from arteries
- (2) Arises from muscle-"factor"

IX. *Cardiac Pain*
- (1) Chemical cause—"factor"
- (2) Mechanical cause—tension

X. *Referred Pain*
- (1) Mackenzies' Theory
- (2) Morley's Theory

FIG. 6

Mackenzie strongly supported Ross's idea of referred pain, but maintained that all visceral pain was of this nature, the viscera being quite insensitive to all forms of stimulation. In agreement with Lennander, he did not believe that the viscera contained pain fibers, true visceral pain was therefore never experienced.

Lewis and Kellgren agree with Lennander and with Mackenzie that the

bowel is not innervated by fibers mediating the sensation of pain. They agree that did such fibers exist they should give rise to pain when stimulated in other ways than by tension, such as by cutting, pinching or burning. These investigators have concluded that the pain of visceral disease and the pain arising in deep somatic structures, i.e. all deep-seated pain, is mediated by a common system of nerves. In their opinion there is no physiological justification for placing visceral pain in a special category.

Lewis and Kellgren concurred with Morley that only those nerve fibers which respond to ordinary forms of stimulation are responsible for the pain of visceral disease, and dissented the necessity of postulating an irritable focus in the cord to explain pain.

Summary

Only the highlights of the great number of investigations pertaining to pain, have been considered in this paper. It is hoped that these will serve as an introduction to the vast subject of pain. (Fig. 6.)

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THE PATHOGENESIS OF HYPERTENSION

RONALD M. BREMNER, M.D., 4T5

Introduction

Factors Responsible for the Arterial Pressure

At the outset it is necessary to consider those factors which combine to maintain the normal arterial pressure. Arterial pressure depends upon the interrelations of:

1) *The minute volume of the heart*—i.e. the cardiac output per minute, which includes both the systolic discharge and the heart rate.

2) *The elasticity of the vessel walls*, particularly the central arteries. This condition of the arteries is concerned mainly with the origin and maintenance of diastolic pressure.

3) *The peripheral resistance*—i.e. the caliber or cross-section area of the vascular bed, chiefly the arterioles, partly the capillaries. Changes in peripheral resistance show their effect predominantly upon the diastolic pressure.

4) *The blood volume*, the total quantity of blood in the arterial system.

5) *The blood viscosity*, which depends on various factors. The level of arterial pressure is determined by the balance between these factors. A normal level does not imply that any or all of these variables are necessarily normal; it merely indicates that the balance is normal.

Estimation of Blood Pressure

At this point we shall make a note regarding the estimation of arterial pressure. The auscultatory indirect technique of blood pressure estimation is quite satisfactory for routine clinical use, as proven by simultaneous direct manometer estimations of blood pressure. Blood pressure measurement should be made only after a suitable period of rest. The point at which the regularly recurring sounds begin should be taken as the systolic pressure; the point at which the sound disappears should be taken as the diastolic pressure, since this point more closely approximates the true diastolic level than does the fourth phase of the Korotkoff sounds.

Normal Blood Pressure

For clinical purposes, the following upper limits of normal blood pressure in the brachial arteries have been chosen arbitrarily: From 3 to 16 years of age—

the systolic B.P. rises progressively from 90 to 115 mm. Hg.
the diastolic B.P. rises progressively from 65 to 75 mm. Hg.
At 40—the upper normal limit is systolic 140, diastolic 90.
Over 40—the upper normal limit is systolic 150, diastolic 90.

Physiological Elevations of Blood Pressure

During health there are physiological elevations of blood pressure which must not be confused with hypertension. These normal variations are transitory and

may be due to changes in posture, exercise, digestion, exposure to cold and nervous disturbances as in emotion, excitement and acute painful states.

Following this brief introduction, the remainder of the discussion will be confined to a consideration of pathological elevations of blood pressure.

Hypertension is a pathological departure of arterial blood pressure above its normal levels. The minimum levels of blood pressure beyond which it can be said hypertension is present have been arbitrarily defined and were stated previously. A condition of hypertension can only result from a change in the factors combining to maintain normal arterial pressure. High blood pressure is not to be considered a disease entity, but rather a sign of altered hemodynamics which may be produced by various mechanisms from different primary disorders. Hypertension is always more or less of subordinate importance to the primary disease.

There is a fundamental differentiation of hypertension which must constantly be kept in mind, namely:

1) systolic hypertension,
and 2) diastolic hypertension, the latter nearly always being associated with a (secondary) systolic hypertension.

Systolic Hypertension

Elevation of the systolic blood pressure with normal or decreased diastolic pressure is in a different category from the various types of diastolic hypertension. The mechanism for the elevation of systolic pressure alone is known and the pathological basis is well understood. Those disorders in which the systolic blood pressure may be elevated with a normal or decreased diastolic blood pressure, and in which, therefore, the pulse pressure is invariably increased are aortic insufficiency, complete heart block, hyperthyroidism and arteriosclerosis of the large arteries.

AORTIC INSUFFICIENCY

The increase in systolic pressure is due to increased systolic discharge; the decrease in diastolic pressure results from two factors—retrograde flow of blood through the aortic valve, and decreased peripheral resistance due to arteriolar dilatation of unknown cause.

COMPLETE HEART BLOCK

The heart rate is slow, but there is an increased cardiac output, resulting in elevation of the systolic pressure. The diastolic pressure is unchanged.

HYPERTHYROIDISM

When metabolism is increased, as physiologically in exercise and pathologically in hyperthyroid disease, the heart rate becomes rapid and cardiac output is increased. In the ordinary case of hyperthyroidism there is only a moderately raised systolic pressure; the diastolic pressure is unchanged.

ARTERIOSCLEROSIS OF THE AORTA AND ITS LARGER BRANCHES

Increased blood pressure is a usual but not invariable concomitant of aging as a result of arteriosclerotic changes occurring in the vessels. In elderly individuals in whom an arteriosclerotic process of the larger arteries results in decreased distensibility of the vessels, the systolic blood pressure is elevated to abnormally high levels. The diastolic blood pressure which would be lowered by the above changes, is, however, usually unaffected, being maintained at normal levels by the increase in peripheral resistance due to thickening of the walls of the smaller vessels and decrease in their lumen.

Elevation of systolic blood pressure alone has little clinical significance.

Diastolic Hypertension

The fundamental hemodynamic alteration responsible for the elevation of the arterial diastolic blood pressure is an increase in the total effective resistance to the outflow of blood from the systemic arteriolar bed. None of the other factors which have been enumerated as sustaining the normal blood pressure exerts an excessive influence in these hypertensive states. The arteriolar vasoconstriction demonstrated to be present in hypertensive subjects would be expected to decrease the cross-sectional area of the arteriolar bed, thereby tending to augment the peripheral resistance. An increased resistance (calculated by relating the mean pressure to the cardiac output) is an inclusive figure and does not necessarily indicate a uniform and equal increase in all the arteriolar resistances throughout the body, but rather is the resultant of the interaction of all the resistances. The demonstration of an increase in the total effective resistance in a hypertensive subject in whom the cardiac output and blood volume and viscosity are normal permits the conclusion that the increased arteriolar blood pressure is the result of a decrease in the total arteriolar cross-sectional area.

In consequence of this vasoconstrictive increase in peripheral resistance, the diastolic blood pressure, which represents the residual impelling force in the circulation during diastole, is elevated. Almost invariably with the elevation in diastolic blood pressure there is a concomitant elevation of the systolic blood pressure, usually to such an extent that the pulse pressure is also increased. Wiggers believes that both anatomical and functional changes in the aortic capacity and/or elasticity, account for the increased pulse pressure observed. Steele believes that the increased peripheral resistance causes an increased mean aortic pressure, which of itself produces passive changes in aortic distensibility that account for the increased pulse pressure.

Increased peripheral resistance in man can result from organic arteriolar changes and from heightened vasoconstrictor activity mediated by neurogenic or humoral means. Neurogenic vasoconstriction may be induced in several ways; humoral vasoconstriction may be due to one of several pressor substances acting locally on the vascular tree.

Hypertension is associated with many different diseases in all of which the one common condition is increased diastolic pressure associated with increased

peripheral resistance. The primary arteriolar disturbance is functional in nature; only later do demonstrable organic changes appear. The mechanisms resulting in increased arteriolar vasoconstriction are unknown, and attempts to classify hypertension on the basis of neurogenic, endocrine, renal or other causes are presumptive. Therefore the various diseases are listed without grouping into divisions which might indicate that each section had its own etiology. Increased arterial blood pressure frequently occurs in patients with the following disease processes:

1. asphyxia
2. increased intracranial pressure
3. endocrine disorders
   a) pituitary tumor—basophile adenoma
   b) adrenal tumor —carcinoma of the cortex
   —pheochromocytoma

4. kidney disease, unilateral and bilateral
   —diffuse glomerulo-nephritis, acute and chronic
   —chronic pyelonephritis
   —renal tuberculosis
   —amyloid disease
   —obstruction of the renal arteries, partial or complete, due to embolism, arteriosclerotic narrowing and tumor without
   —periarteritis nodosa of the renal arteries
   —polycystic renal disease
   —renal neoplasms: Wilm's tumor, carcinoma
5. primary or essential hypertension = hyperpiesia = hypertensive disease
6. specific hypertensive disease in toxemia or pregnancy
7. coarctation of the aorta.

Each of these diseases will now be further discussed with regard to its relation to diastolic hypertension.

ASPHYXIA

Asphxia in animals will produce a pronounced rise in blood pressure due to a generalized vasoconstriction resulting from the reduced oxygen supply to the vasomotor centre in the medulla. The hypertension found in man during asphxia is very probably due to the same mechanism.

INCREASED INTRACRANIAL PRESSURE

Increased intracranial pressure (as found with meningitis, brain abscess, hemorrhage and tumor) compresses the cerebral veins and capillaries, thus interfering with the blood flow through the brain. A cerebral anemia results which affects the vasomotor centre. To overcome this diminished cerebral circulation, there is a compensatory rise in blood pressure, apparently due to a generalized vasoconstriction as in asphyxia.

ENDOCRINE DISORDERS

BASOPHILE ADENOMA OF THE PITUITARY (*Cushing's Syndrome*)

The hypertension associated with pituitary basophilism is probably the result of adrenal cortical stimulation.

CARCINOMA OF THE ADRENAL CORTEX

The hypertension is apparently due to the liberation of excess pressor substance from the cortical tissue.

PHEOCHROMOCYTOMA = CHROMAFFINOMA = PARAGANGLIOMA

The high blood pressure associated with this rare tumor of chromaffin tissue, usually of the adrenal medulla, is occasionally persistent, commonly paroxysmal. It is due to the periodic discharge of a highly potent pressor substance, probably adrenalin, into the blood stream.

KIDNEY DISEASE, UNILATERAL AND BILATERAL

Experimental Evidence

Divergent opinions have long been held regarding the manner in which the increased peripheral resistance in renal disease occurs. In acute nephritis, the vasoconstriction is apparently of nervous origin. In other nephropathies, the modern conception of the production of hypertension originated from the work of Goldblatt and his associates who were the first to show that renal ischemia due experimentally to compression of both renal arteries in animals causes consistently a marked and permanent hypertension. This hypertensive effect is not dependent upon nervous mechanisms. It is generally believed that the hypertension produced by hindering the blood supply to the kidney is due to a pressor (i.e. vasoconstrictor) substance produced in the organ. However, in spite of indirect evidence that the ischemic kidney elaborates a pressor substance, attempts to demonstrate the presence of this substance in a direct way in the blood of the hypertensive animals (and man) have been unsuccessful. The pressor substance is generally referred to as *renin*. Blood plasma appears to contain an activating material which has been termed *renin activator*. The active material so formed is called *angiotonin* or *hypertensin*, and has been isolated in crystalline form. This hypertensive principle acts not through the vasomotor centre, but either directly upon the peripheral vascular bed or through the intermediary of an endocrine organ—the former generally conceded to be the correct mechanism. Clinically, angiotonin produces and elevation in the systolic and diastolic blood pressure accompanied by an increased pulse pressure. Observations indicate that normal renal tissue elaborates a substance which inhibits the action of the pressor agent. This concept forms the basis for current attempts to treat hypertension by feeding or injecting renal extracts.

Renin is confined to the cortex of the kidney. The cells of this region which actually produce or store the pressor substance appear to be closely associated with the glomeruli and may be the cells of the juxta-glomerular apparatus. How-

ever, the theory that the juxta-glomerular apparatus can hypertrophy and cause the secretion of a pressor principle has not been confirmed in man. The stimulus which induces the production or liberation of renin by the kidney is unknown. Ischemia does not appear to be directly responsible. The demonstration that renal blood flow may be quantitatively normal in the presence of renal experimental hypertension has led to the theory that the hypertensive mechanism may be reduction in intrarenal pulse pressure. It has been suggested that the pressor factor serves as a physiological mediator of renal blood flow.

It may well be that there is a renal mechanism in the causation of hypertension dependent not upon a diminished blood flow, but upon a metabolic fault in the kidneys. It is well-known that some amines exhibit a marked pressor action when injected intravenously into animals. The two major processes involved in the breakdown of amino-acids are decarboxylation and deamination; the former may be accomplished in the absence of oxygen, but the latter occurs only in its presence. It is an interesting speculation, therefore, that disturbances in renal blood flow other than quantitative dimination may so reduce available oxygen in the kidney as to render the amine oxidases incapable of completing the process of deamination. Absorbtion of amines into the blood stream would then result in widespread vasoconstriction and elevated blood pressure.

In summary, experimental renal hypertension is brought about by a peripheral vasoconstriction due probably to the presence in the circulation of a pressor substance which is believed to be derived from the interaction of renin from the renal cortex and an activator in the blood plasma. The pressor substance has been called angiotonin and hypertension. An anti-pressor substance is believed to exist which is capable of inactivating the pressor substance.

Clinical Evidence

A primary renal mechanism has been established in the etiology of experimental renal hypertension. This has led to an assumption that a similar mechanism operates in human hypertension.

(1) In Unilateral Renal Disease

There is no convincing proof that unilateral renal disease can initiate hypertension in man. Apparent cure of hypertension following nephrectomy has occurred, too infrequently to establish such a relationship. Other evidence such as the incidence of unilateral intrinsic renal disease in hypertensive patients, and the incidence of hypertension in unilateral intrinsic renal disease is untenable. It appears, however, that a mechanism analogous to the experimental procedures described by various investigators (i.e., obstruction of the renal artery) can initiate hypertension in man, but such occurrence is extremely rare, only four probable instances being cited in the available literature.

It must be concluded that there is no proven relationship between hypertension and unilateral renal disease.

(2) In Bilateral Renal Disease

That a renal mechanism is a prime factor in the origin of hypertension in man can be accepted in (1) cases of bilateral intrinsic renal disease, and (2) those rare instances where the pathological process is analogous in its effect to the procedures used in the production of experimental renal hypertension. However, the mechanism involved in the production of these instances of human hypertension is unknown.

PRIMARY OR ESSENTIAL HYPERTENSION = HYPERPIESIA

Hyperpiesia is a persisting, usually progressive, elevation of blood pressure, due to constriction, at first functional and only later organic, of arterioles widely distributed in the body, and occurring in individuals who have no disorders which are known to result in elevation of the blood pressure. The hypertension varies in severity and may be "benign" or "malignant" but the nature of the process is essentially the same.

The actual level of blood pressure does not necessarily reflect the severity of the disease. The blood pressure level may fall spontaneously at variable intervals for variable periods during the course of the disease, and may fall even from known factors (e.g., myocardial infarction, fever). The blood pressure level may fluctuate in a wide range of hypertensive levels for no apparent reason. Elevated blood pressure is merely a manifestation of a fundamental fault which continues to operate despite artificial lowering of the blood pressure level. Therapeutic agents directed solely towards reduction of the blood pressure level are concerned with incidental factors and neglect the primary cause.

Essential hypertension comprises the great majority of all hypertensive patients. Existence of a definite hereditary tendency has been established. It usually develops after the fourth decade of life. It is frequently associated with obesity. Certain clinical findings are stated to be indicative of a pre-hypertensive state. These include lability of blood pressure indicated by temporary elevations of blood pressure in otherwise normal individuals and excessive elevation of the blood pressure of normal individuals in response to a standardized stimulus, the immersion of the hand in ice-water. However, the existence of a pre-hypertensive phase has not been established.

The cause of the peripheral vasoconstriction in essential hypertension is unknown. Many theories have been proposed and include the following:

1. *Endocrine influences.* There is no evidence of recognized hormones playing a role in essential hypertension.
2. *Nervous influences*, such as
   (*a*) exaggeration of the usual vasomotor response, due to an inherent hypersensitivity of the vasoconstrictor nerves.
   (*b*) generalized vasoconstriction similar to the reaction produced in asphyxia but due to interference with circulation in the medullary centres as a result of local vascular disease.

3. *Renal ischemia.* This does not seem to be the primary etiological agent in human hyperpiesia for the renal ischemia observed in hypertensive patients appears to be a result of the hypertensive process.

It is concluded that at this time the origin of essential hypertension is unknown.

SPECIFIC HYPERTENSIVE DISEASE OF PREGNANCY

Hypertension occurring in pregnancy may be a manifestation of specific hypertensive disease peculiar to pregnancy or of a pre-existing primary renal disease or pre-existing essential hypertension. In specific hypertensive disease of pregnancy, the failure to find reduction in renal blood flow indicates that the hypertension on this disease is not the result of renal ischemia. The origin of hypertension in this disorder is quite obscure.

COARCTATION OF THE AORTA

Experimentally it has been shown that following constriction of the aorta in animals, hypertension in the upper half of the body occurs only when the constriction is above the orifices of the renal vessels.

Clinically, review of the knowledge of levels of arterial pressure in over 200 cases of coarctation of the aorta makes untenable the assumption that increase in peripheral resistance is situated in the upper half of the body only. The demonstration by Steele that on direct measurement hypertensive levels of diastolic pressure are found in the femoral as well as in the radial arteries in cases of coarctation of the aorta indicates a general increase in arteriolar tone throughout the body. Although the mechanism responsible for the production of the hypertension in this disorder is unknown, it is no longer warranted to ascribe the increase in blood pressure directly to the resistance offered by the stenosis of the aorta. In so far as the distribution of peripheral arteriolar resistance is concerned, arterial hypertension in coarctation of the aorta does not differ from the common forms of hypertension.

This completes a consideration of the pathogenesis of diastolic hypertension due to an increase in the peripheral resistance as defined in the introduction. There are still to be considered two factors responsible for the arterial pressure, an increase in which may account for arterial hypertension—namely, the blood volume and the blood viscosity. (Some physiologists, among whom are Bard and Wright, consider blood viscosity as an integral part of the peripheral resistance.) Although there are many conditions which may alter these factors, there is only one clinical entity in which the alteration may be of such proportions as to significantly increase the blood pressure, and that in polycythemia. In POLCYTHEMIA VERA, both the volume of the blood and the viscosity of the blood are greatly augmented. The blood pressure is sometimes but not always raised. It has been suggested that in those cases in which hypertension is found, it may be due to an associated hyperpiesia.

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Feature

C. A. F. MÖES, Editor

MEDICAL SOCIETY REPORT

The following is a brief report of the activities of the Medical Society in the period between January and May of 1945.

The new Society started off very favourably from a financial viewpoint, $900, the profits of the Meds' At Home being lodged in the treasury by Doug Rae. This allowed the finance committee of the Society to meet successfully the onslaughts of the Athletic Society, the Medical Journal, C.A.M.S.I., and the Arts and Letters' Club, and also to budget sufficiently to meet the expected demands in the fall term.

Mr. Slater secured Ellis McClintock for the coming At Home. The Medical Society can assure the Medsmen and their girls that this dance will not be a repetition of the last.

The Red Cross Appeal was brought to the attention of the Society by one of the Meds fellows and a drive was organized in the faculty. Over $200 was collected—Mr. Salter and the Fourth Year deserving much of the credit in this respect.

The I.S.S. drive was met by the Society with a collection and a play for skit night, both were greatly appreciated.

Mr. Stephenson and Mr. Slater revised the constitution of the Medical Society, bringing it up to date with the changing years, and throwing out many obsolete, unneeded portions.

The indoctrination and cultivation of Medical spirit (you know . . . . yea Meds, dirty School!) was the topic of several meetings. Among other suggestions which were considered of worth, are the production of a meaningful initiation guaranteed to make the frosh boastful of the fact that they are Meds, and also the composition of a new and spirited Meds Yell. We have invited the talented members amongst the medical students to put their brains together and produce a Meds Yell which will carry us to the T. A. Reed Trophy.

An Initiation Committee was formed of several Society members appointed to prepare an "Introduction," which, if successful, would be standardized for use in future years.

The production of a play somewhat like Daffodil Nites of yore is now underway. As you know this is a very ticklish subject, for certain staff members, in the past have not always approved of the context of this production. However, these difficulties have mostly been surmounted. The future rests now with the student body of the faculty of Medicine to make Daffodil a success. Step in behind Mr. McBirnie, chairman of the Daffodil Committee, and let's put on a grand show.

And these are the highlights of the twelve Medical Society meetings of the Spring term.

CAM HILL, *Secretary*

Abstracts

M. ST. AUBIN, Editor

CONTRIBUTORS

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MEDICINE I

KULLMAN, H. AND CRELLIN, J. A. Penicillin in Suppurative Disease of the Lungs due to Strep. haemol. Ann of Int. Med. *23* (2): 135. August, 1945.

THE advantage of penicillin over the sulphonamides is not only that it cures sulphonamide resisting cases, but also that it is not inactivated by large quantities of pus and bacteria, so that it is effective when placed directly into the infected cavity.

The authors describe six cases of streptococcal pneumonia, two of which had also suphonamide resisting pulmonary abscess, and the four others suppurative pleuritis, one with added scarlatina.

The empyema cases received intrapleural injections and in three patients pleural cultures were negative after 24-36 hours. The treatment for the abscesses was at first intravenous and later intramuscular therapy. The duration of less treatment in these six cases varied from 8 to 24 days, and the total amounts of penicillin given from 400,000 to 3,020,000 units.

L. A.

MEDICINE II

EFFECT OF LIVER DISEASE ON VITAMIN A METABOLISM. Adlersberg, Sobotka and Bogatin *Gastroenterol* 4: 164, 1945.

THIS article deals with the response to an oral dose of vitamin A in 50 controls and 50 cases of liver disease. Associated with severe hepatic damage were abnormally low levels of vitamin A in the blood serum. It was shown that there was definite correlation between the changes of vitamin A metabolism and liver function tests and thus proved to be of diagnostic value in the follow-up of liver disease.

There was a gradual return to normal levels of vitamin A in the serum as clinical improvement showed itself. The test consisted of a standard dose of 180,000 units of the vitamin, followed by a test meal of 30-50 cc. of orange juice containing fish liver oil, a slice of toasted white bread and a cup of tea. Before the test 10 cc. of serum is obtained to determine the fasting blood level for vitamin A. Four hours after the test has begun a second sample is obtained to determine the level for vitamin A.

In the controls the fasting level was on the average 60 micrograms per cent and after the four hour period the level had risen from 50 to 100 per cent.

Severe or prolonged hepatic damage resulted in a low vitamin A content of the blood and oral administration of vitamin A caused little if any change in this level.

Thus the vitamin A level of the blood serves as a useful index of the state of liver disease and also serves as a means of determining the direction in which the disease is heading.

M. S. A.

SURGERY I

THE EFFECT OF SULPHANILAMIDE AND SULPHATHIAZOLE ON HUMAN TISSUE. Posch, Maun, Pilling, Hirshfeld. *Surgery Gynecol. and Obstet.* 1945, Feb., v. 80, no. 2.

THE conflicting evidence in the literature regarding the effects of the sulphonamides on the tissues when applied to the wound locally is reviewed at the beginning of this paper.

The paper then deals with the observations afforded by two volunteers in whom two incisions 2 cms. long and extending down to the muscle were made in the paravertebral region. Sterile sulphanilimide and sulphathiazole was inserted in both wounds which were then sutured.

The wounds were excised after given periods. After one week there was a leucocytic exudate, focal necrosis, acute inflammation about some granules of the drug and a foreîgn body reaction about other granules—observed in the deep layers of the dermis and in the subcutis. Epithelial growth was uninhibited but fibroblastic proliferation was somewhat delayed. After one to two weeks healing was comparable in all wounds. After three weeks the wounds showed almost complete repair.

The conclusion resulting from this piece of work was that sulphanilamide and sulphathiazole are irritants to the dermis and subcutis but that their bad effects last usually less than a week.

M. S. A.

SURGERY II

TREATMENT OF COMPOUND FRACTURES BY EARLY WOUND SUTURE AND PENICILLIN. Bentley, Thomson, Bingham, Key and Wostenholm. *Lancet*, 1945, Feb. 24.

THIS article deals with the experience of the authors in the procedure of early wound closure and penicillin locally and parenterally in a group of 62 compound fractures. The majority of these patients were casualities arriving at the hospital as long as four days after being wounded. These men had received sulphonamides orally and were allowed to rest a day before surgical interference of any type was attempted.

The fracture site was first X-rayed. The wound was then explored surgically with a minimum of skin excision. Any devitalised necrotic tissue, any foreign bodies were carefully but thoroughly removed from the wound. Drainage tubes were then passed into the depths of the wound by way of two stab incisions. These tubes which reached the fracture hematoma were so placed as to serve the purpose of drain (or aspiration) and also for instillation of penicillin.

The wound was sutured with a fair degree of tension and as this was not feasible a Thiersch graft was applied to the open area. A dry dressing was applied

and the limb immobilized in a plaster cast through which the tubes were brought out.

Twenty-five hundred units of sodium penicillin in 5 cc. solution was introduced into each of the drainage tubes immediately after operation and 1500 units twice daily for the next five days. Parenteral penicillin was given in addition in some cases with no improvement in results.

The results were primary wound healing and union of the fracture in 58 out of the 62 cases. Two wounds broke down because of suturing under too great tension; two because of the presence of foreign bodies in the wound.

M. S. A.

UROLOGY I

KICKHAM, C. J. E. Obstruction of the Ureter in Children. The Journal of Urology, *53*:(6):776. June, 1945.

THE author advocates that more emphasis should be placed on early diagnosis and prompt treatment of urinary tract diseases and abnormalities in early life. Restorative surgery can often repair early ureteral blockage, whereas neglect necessitates removal of the afflicted kidney later on. Excretory urography and laboratory studies facilitate the examination of the tract. Intravenous urography is ideal for measuring anatomical and functional restoration following surgery.

Indicating the necessity of a thorough examination of the urinary tract is urine which persistently contains pus and remains microscopically and culturally positive, in spite of medical treatment; persistent vesical irritation; especially enuresis; blood in the urine; and an enlarged kidney, even if painless. The pain of a diseased kidney or ureter often causes the diagnosis of appendicitis.

Congenital obstruction affects chiefly the ureter, but may also be caused by stenosis of the external urethral meatus, valves of the posterior urethra, hypertrophy of the vera, and obstruction of the bladder neck.

In operations as much kidney as possible should be preserved, except in malignant disease and tuberculosis. The successful result should be confirmed by urography after the post-operative period, since the silent destruction of a kidney may give the false impression of a cure.

The type of operation chosen must depend on the individual case. Diversion of the urine by temporary nephrostomy with high fixation of the kidney and splinting of the upper ureter by means of a catheter is always advisable.

Five basic techniques are used for relieving stenosis:

(1) Reimplantation of the excised ureter into the most dependent portion of the pelvis.

(2) Longitudinal incision with transverse closure.

(3) Y incision with V closure, or

(4) Incision of valvelike partition downwards without suture, for high insertion of ureter.

(5) A few parallel vertical incisions through the serosa and muscle coat, leaving the mucosa intact, for true stenosis. If hydronephrosis is marked, partial resection of the sac is of advantage.

L. A.